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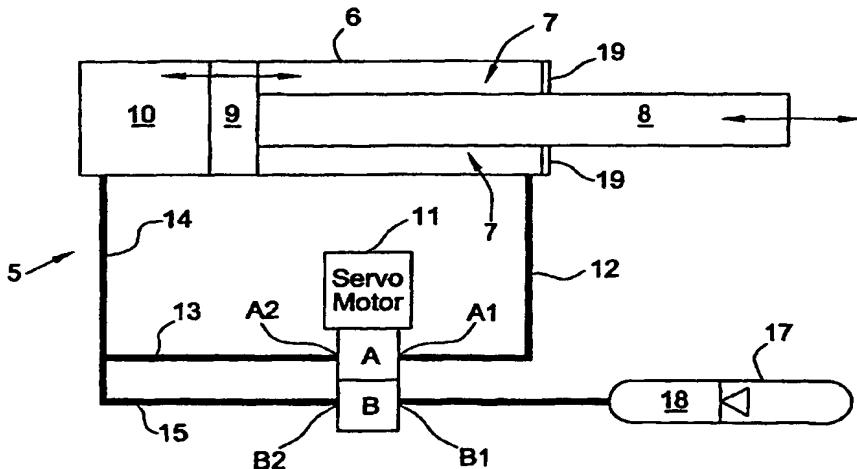
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(54) Title: APPARATUS AND METHODS FOR ACTUATION



(57) **Abstract:** There is disclosed an actuator (5) having an actuator chamber (6) and actuator piston (9) therein defining an extend chamber (10) and a retract chamber (7) separated from the extend chamber by the actuator piston. A first fluid pump (A) is in fluid communication with the extend chamber and the retract chamber and is arranged to transfer therebetween volumes of fluid substantially equal in magnitude to changes in the volume of the retract chamber resulting from movement of the actuator piston within the actuator chamber. A second pump B connected to the extend chamber and to an accumulator (17) allows the differential volume between the extend and retract chambers to be displaced into the accumulator at a pressure. Stored accumulator fluid pressure enables pump B to be back-driven so that it behaves as a motor whenever the pressure in conduit 15 is less than in conduit 16. A pre-charge (20) unit pressurises the system until full mass counterbalance of the suspended load is achieved. In this state little or no input power from the servo motor (via pumps A & B) will be needed and significant energy savings can be made.

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